Code No. 2387 / N

FACULTY OF ENGINEERING

B.E. 3/4 (Mech.) II-Semester (New)(Main)Examination, May 2013

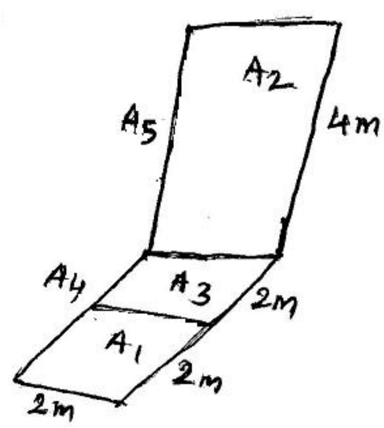
Subject : Heat Transfer

Time : 3 Hours **Max. Marks: 75**

Note: Answer all questions of Part - A and answer any five questions from Part-B.

PART – A (25 Marks)

1. What is Fourier's law of conduction? State the assumptions on which this law is based.
2. Derive the equation for steady state heat conduction is a composite slab with fluid flowing on the surfaces.
3. Explain importance of insulated tip solution for the fins used in practice.
4. Derive an expression for temperature distribution in a lumped system.
5. Define the critical Reynold's number.
6. Differentiate between natural and forced convention.
7. Define solid angle with help of a diagram.
8. Calculate the shape factor F12 of the figure shown below



9. Write a formula to calculate the overall heat transfer coefficient based on outer diameter and inner diameter and with following factor.
10. What do you mean by pool boiling ? How does it differ from forced convention boiling?

PART – B (50 Marks)

11. Consider a slab of thickness 1.2 cm whose thermal conductivity is 25 W/m.K. Heat is generated within the slab at the rate 10^8x W/m^3. Calculate the temperature for the following conditions. Assume T_a=120^oC,
h=4000 W/m^2 - K
(a) Both sides of the slab have different temperatures, given that T_2=300^oC.
(b) Both sides of the slab have the same temperature, given that T_{max}=600^oC
(c) The wall is insulated at x =0, if T_2=120^oC
(d) The wall is insulated at x=0, and heat is connected away into the fluid at x = L.

12. A metal plate of 5cm thickness is initially at 300^oC. Suddenly it is exposed to an ambient at 30^oC with a convective heat transfer coefficient of 500 W/m^2K calculate.
(a) The centre temperature at t = 2 minutes after the start of the cooling.
(b) The temperature at a depth of 1.0cm from the surface at t=2 minutes offer the start of the cooling.
(c) The energy removed from the plate during this time of 2 minutes. Assuming surface area of $2m^2$.
Assume K = 60 W/m-K, C = 460 J/kg, ρ = 7850 kg $/m^3$
$\alpha = 1.6 \times 10^{-5}$ m^2/s of the metal plate

13. The resistance R experienced by a partially submerged body depends upon the velocity V, length of the body l, viscosity of the fluid , density of the fluid and gravitational accelerating 'g'. Establish a suitable relation involving non-dimensional groups.

14. Two black discs each of diameter 50 cm are placed parallel to each other concentrically at a distance of one meter. The disc are maintained at 1000K and 500K respectively. Calculate the heat flow between the discs.
    (i) When no other surface is present
    (ii) When the are connected by a cylindrical black no-flux surface.

15. Saturated water vapour at 25 bar enters into the tube of a shell and tube type of heat exchanger. The flow rate of saturated water vapour is 1 kg/s. The water vapour is to be subcooled to 200^{o}C. The water is used as a coolant at the rate of 5 kg/s available at 15^{o}C. Calculate the area required for the following case.
    (a) Parallel flow (b) Counter flow. Assume an overall heat transfer coefficient of 1100 W/m^{2}K.

16. A cylindrical fin is attached to an outer surface of a furnace to transfer heat. The temperature of the outer surface of the furnace is 30^{o}C. The diameter of the fins is 3 cm and length is 50 cm. The temperature at the tip of the fin is 50^{o}C. Assume a connective heat transfer coefficient of 25 W/M^{2}k. Calculate
    (a) The thermal conductivity of the cylindrical fin and
    (b) The rate of heat transfer. Assume ambient temperature 30^{o}C.

17. Derive the equation for laminar film wise condensation on a vertical plate and show that

$$\delta = \left[\frac{4k\mu(T_{sat} - T_s)x}{g.\rho\ell(\rho\ell - \rho v)_{hf}\, g} \right]^{1/4}$$

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